AMERICAN CHEMISTRY COUNCIL
2002 ENERGY EFFICIENCY AWARDS PROGRAM
AWARD WINNERS AND SUMMARY DESCRIPTIONS

Number: **1**
Company: Texas Petrochemicals LP
Category: Significant Improvement in Manufacturing – Plant Site
Entity: Houston, Texas Plant
Title: Advanced Controls - Phase I

Description: In 1999 Texas Petrochemicals LP had installed a distributed control system (DCS) which allowed significantly better control of plant operations. Continuing its multi-year pursuit of energy reduction, in 2002 the company implemented the first phase of its advanced controls project to further increase processing efficiency and lower overall energy per pound of product. In 2002 a robust multivariable predictive control technology system, or RMPCT, a Honeywell technology product, was implemented to enhance operation of the DCS. The RMPCT technology allows for simultaneous control of many process variables. The process is modeled using on line "step testing" and model predictions are used to guide the independent controllers. The RMPCT controllers allow tighter process control, leading to higher product yields and increased energy efficiency. To date controllers have been installed on 8 distillation towers, with 6 towers remaining. With increased production in 2002, annualized energy savings are 2.7% per pound of product, equivalent to 663,817 MMBTU, with related CO_2 emission avoidance of 23,904 tons.

Number: **2**
Company: Vulcan Chemicals
Category: Environmental Impact - Plant Site
Entity: Wichita, Kansas Plant
Title: Boiler Energy Use and Chemical Cost Reduction

Description: In the context of rising natural gas prices and the imperative of reducing fixed and variable costs in all categories, a team was formed to focus on the operation of the site's three boilers. Blowdown from the steam generation equipment was thought to be excessive, and reduction of blowdown would reduce not only energy input, but also the usage of boiler treatment chemicals and related disposal costs. Controlling blowdown was a problem in that both water conductivity and alkalinity were never quite correct. Both could not be optimized simultaneously. Analysis indicated that existing valves did not provide fine enough control. More precise metering valves were installed which were able to achieve the objective of increasing the cycles of the boiler and minimizing the blowdown volume and chemical usage. Specifically, use of caustic for alkalinity purposes was completely eliminated and the boilers were able to be cycled up from 25 to over 90 cycles. The quantity of boiler blowdown was reduced from about 27 gpm to less than 10 gpm. As a result, the amount of chemicals used for treatment, the amount of heat required, and the volume of blowdown for disposal were all reduced. Annualized energy savings are 0.67%, equivalent to 18,000 MMBTU, with a related CO_2 emission reduction of 1,044 tons.

Number: **3**
Company: Arch Chemicals, Inc.
Category: Energy Efficiency Program – Plant Site
Entity: Brandenburg, Kentucky Facility
Title: Reduction in Unit Steam Production

Description: In 2001 the company's Arch-Brandenburg facility faced increased steam costs due to high natural gas prices and decreased production due to shutdown of a process. The facility was challenged to reduce unit steam consumption to minimize the effects of these events. Multi-functional energy teams were established to identify sources of wasted steam and to recommend improvements. Five steps were utilized to approach the challenge: 1) metering was improved; 2) consulants were used to help; 3) a list of

projects with significant energy reduction potential impact was developed; 4) projects were prioritized according to potential impacts and cost/benefit analysis; and, 5) projects were implemented based on the cost/benefit analysis. Among the kinds of projects identified were boiler efficiency optimization, heat recovery, reduction in lost and wasted steam and conversion to less energy intensive processes. For example, one high priority project involved heat recovery from distillation column overhead condensers. Previously, the water was returned to the cooling tower at 130 degrees F and re-cooled. This water is now re-routed to preheat raw boiler feed water. The feed water, in turn, is obtained from groundwater recovery wells at 60 degrees F. The re-routed condenser water now preheats the feed water to approximately 120 degrees F, saving energy formerly required both to heat the feed water and cool the condenser water when it is returned to the cooling tower. A higher level of awareness surrounding steam usage is now evident at all levels of the facility. Notwithstanding the successes of this program to date, additional energy efficiency gains are necessary to keep this facility's products competitive. Annualized energy savings are 170,589 MMBTU, or 11% per unit of production, with a related emission reduction of CO_2 and other greenhouse gases of 9,612 tons of CO_2 or CO_2 equivalent.

Number: **4**
Company: Celanese
Category: Significant Improvement in Manufacturing – Operating Unit
Entity: Clear Lake, Texas Plant
Title: Reaction and Purification Six Sigma Study

Description: Six Sigma is a statistical approach to improving complex systems such as continuous chemical processes. With this methodology, control variables in the process are identified, and then manipulated in the process using a designed experiment to measure the effects. Results are analyzed using specialized statistical tools which identify the *key* control variables and where they should be run to achieve the optimal result. Once analysis is completed, Six Sigma ensures that improvements are maintained through use of a Control Plan. The Clear Lake Plant used Six Sigma to study the reaction and purification sections of a chemical process. In the reaction area of this process, the goal was to improve efficiency when the unit was running at low production rates. In the purification area, the goal was to minimize waste and recycle streams that result in raw material, product and energy losses. In both areas new combinations of operating conditions were found that resulted in energy savings as well as improving raw material efficiency and increasing production. Among the specific improvements was reduced steam use for a major turbine driver and several distillation column reboilers. This activity required no capital expenditure. Annualized energy savings from this project are 2% per pound of production, equivalent to 86,000 MM BTU, with a related CO_2 emission reductions of 4,988 tons.

Number: **5**
Company: Celanese
Category: Significant Improvement in Manufacturing – Operating Unit
Entity: Clear Lake, Texas Plant
Title: Incinerators Optimization Six Sigma Study

Description: Six Sigma is a statistical approach to improving complex systems such as continuous chemical processes. With this methodology, control variables in the process are identified, and then manipulated in the process using a designed experiment to measure the effects. Results are analyzed using specialized statistical tools which identify the *key* control variables and where they should be run to achieve the optimal result. Once analysis is completed, Six Sigma ensures that improvements are maintained through use of a Control Plan. The Clear Lake Plant operates several vapor incinerators, which are significant users of fuel gas. A Six Sigma analysis of the incinerators was undertaken to determine if fuel gas use could be reduced while maintaining safe operation and environmental compliance, specifically required destruction efficiency. The analysis indicated that poor control resulted in excess combustion air being introduced into the incinerators. The key variable was identified as stack O_2 concentration. By modifying operating limits slightly and by keeping strict control over this variable, the excess air could be minimized and the project's goals achieved. This activity required no capital expenditure. Annualized energy savings from this project ore 9%, equivalent to 91,000 MMBTU, with a related CO_2 emission reduction of 5,278 tons.

Number: **6 and 7 jointly**
Company: Sasol North America, Inc.
Category: Significant Improvement in Manufacturing – Operating Unit
Entity: Lake Charles, Louisiana Chemical Complex - Ethylene Unit
Title: Energy Efficiency Performance Improvement - Cold Side and Hot Side

Description: The company used pinch technology to evaluate the heat exchange networks on both the "cold side" and the "hot side" of the ethylene unit of its Lake Charles Chemical Complex. The cold side uses steam turbine-driven refrigeration compressors to provide cooling for separation of products produced in the cracking section (hot side) of the unit. On the cold side, the company identified an opportunity to reduce refrigeration compressor horsepower requirements by increasing the amount of feed vaporized by cooling process streams, and interchanging more heat between process streams. Additionally, the project was expected to reduce consumption of steam being used to vaporize the feedstock. Service was changed on an existing exchanger to use the feed for cooling instead of refrigerant, and a new, larger exchanger with less potential to foul was installed during a planned outage in mid-year. These modifications worked better than expected. On the cold side, annualized energy savings per unit of production were 1.8%, equivalent to 191,000 MMBTU, with related CO_2 emissions reductions of 12,200 tons. The hot side of the unit recycles water as dilution steam for its cracking furnaces. The water is stripped of light hydrocarbons in a stripping column and then vaporized in a steam generator. The stripper overhead was used to preheat column feed and the steam generator bottoms were used to heat condensate used in other on-site boilers. On the hot side, the company identified an opportunity to reduce steam consumption by installing additional exchangers to recover heat from the overhead of the water stripper and the blowdown of a steam generator. On the hot side, annualized energy savings per unit of production are 0.7%, equivalent to 80,000 MMBTU, with related CO_2 emissions reductions of 5,100 tons. Combining the results of both cold and hot sides results in annualized savings of 271,000 MMBTU, with a related CO_2 emission reduction of 17,300 tons.

Number: **8**
Company: Sasol North America, Inc.
Category: Significant Improvement in Manufacturing – Project
Entity: Lake Charles, Louisiana Chemical Complex - Ethylene Unit
Title: Compressor Horsepower Reduction Project

Description: This ethylene unit compresses a process stream from its cracking furnaces to a sufficient pressure for separation by distillation. The compressor train uses large amounts of steam. It has multiple stages of compression, interstage coolers, separation vessels and absorption columns, and had large pressure drops in this system. In addition, the compressor fouled between planned outages, further increasing horsepower requirements. The area in which this equipment is located is very congested. Therefore, the challenge was to reduce the pressure drops in the system, thus reducing compressor horsepower requirements, and to reduce fouling, while still fitting into the existing, congested area. To reduce pressure drop larger piping and vessels were installed and piping runs were modified to fit in the existing area. A new exchanger bundle was installed with a spiral baffle, thus reducing pressure drop withou increasing the shell size. The column was repacked to reduce pressure drop. Finally, the compressor wheels were coated with a "non-stick" coating to reduce fouling and horsepower requirements. Annualized energy savings achieved by this project were 0.9% per unit of production, equivalent to 92,000 MMBTU, with a related CO_2 emissions reduction of 5,900 tons.

Number: **9**
Company: Merck & Co., Inc.
Category: Environmental Impact – Project
Entity: Rahway, New Jersey Site
Title: Fuel Cell Installation Project

Description: Building 28 at the company's Rahway site is an office and laboratory facility with multiple 100% outside air fan systems. In this project a fuel cell was installed in parallel to the electricity grid connection and now supplies 50% of the building's electrical load. In addition, although heat

produced by a fuel cell is often rejected to the atmosphere through an air-cooled condenser, in this project 900,000 BTU/hr of usable waste heat is piped to a glycol water heat exchanger which serves the building's reheat and preheat systems, reducing the previous need for 15 psig steam from another source. With this heat recovery option, the fuel cell has an efficiency of 80%. Annualized savings are 32% of the building's energy needs, equivalent to 7,730 MMBTU, with a related CO_2 emissions reduction of 450 tons.

Number: **10, 11, 12 and 14 jointly**
Company: Merck & Co., Inc.
Category: Non-Manufacturing Improvement – Plant Site
Entity: Rahway, New Jersey Site
Title: Building Efficiency Improvements

Description: The company made significant energy efficiency improvements to several non-manufacturing buildings at its Rahway site. (1) Two 10,000 ft^2 office facilities were experiencing water damage and heating problems. Inspection revealed that seals around all windows, as well as seals around the operable section of the windows, had failed and were allowing major infiltration of air and water during periods of high wind and rain. All 1,287 windows in the two buildings were replaced with high performance double pane glazed windows. These windows have a static design, that is, no operable sections, thereby eliminating wear and tear of the window seal caused by opening and closing. Annualized energy savings from this project were 22% of building energy requirements, equivalent to 20,338 MMBTU, with related CO_2 emissions reductions of 1,224 tons. (2) In Building 121 Lab 100, a constant volume HVAC lab system was replaced with a variable speed / variable air volume system. The project installed variable frequency drives for the air supply and exhaust fans, replaced exhaust fan motors with high efficiency TEFC motors, and upgraded all building automation. The result was decreased steam load in heating the air into the labs, decreased chilled water load to cool the supply air and reduced electrical consumption for motor operation. Annualized savings were 15% of building energy requirements, equivalent to 4,507 MMBTU, with related CO_2 emissions reductions of 271 tons. (3) Building 800 is a research laboratory building with 270 eignt-foot triple sash fume hoods. Fume hoods left open when unattended allow heat or cooling to escape to the outside. A "Fume Hood Closure Initiative" was created to encourage the scientific staff to close their hoods when not in use. Each lab occupant was given an "Award of Excellence" in recognition of their participation in this initiative. Three unannounced inspections were conducted; for the lab to pass, each and every fume hood had to be closed for every inspection. This system successfully modified the behavior of the scientific staff to ensure their fume hoods were closed when not in use. Energy savings from this program were 16.8% of building energy requirements, equivalent to 21,555 MMBTU, with related CO_2 emissions reductions of 1,250 tons. (4) Also in Building 800, the Building Automation System was utilized to automatically reduce the temperature setpoints of laboratory offices from 8:00 p.m. to 6:00 a.m. weekdays and all day on weekends. A light switch is used as the control flag; when the switch is turned off, the offices automatically go to their unoccupied temperature setpoints. The light switch also provides override for any occupant. Additionally, this project installed occupancy sensors to turn off task lighting, computer monitors and printers when the space is unoccupied. Annualized energy savings are 0.1% of building energy, equivalent to 119 MMBTU, with related CO_2 emissions of 7.2 tons. The combined energy savings of these four projects amounted to approximately 13% of the involved buildings' combined energy requirements, equivalent to 46,519 MMBTU, with a related CO_2 emission reduction of 2,752 tons.

Number: **15**
Company: BASF Corporation
Category: Energy Efficiency Program - Plant Site
Entity: Portsmouth, Virginia Site
Title: Site Energy Team

Description: The prior corporate owner of this site had not focused on energy management. Although opportunities for energy conservation were certain to exist no means was in place for easy identification of these opportunities. The site was a high cost producer of its products. The challenge thus was to orient the newly-acquired site to BASF Energy Management methods of efficiency improvement. A Site Energy Team was created to champion the site's energy conservation efforts. The team consisted of

representatives from all major departments on site as well as from the corporate level energy management function. The team's charter included not only addressing dynamic energy users but also developing management strategies. Among other things the team developed a project tracking methodology and a project to improve site metering so as to establish Specific Energy Ratios (SER) for various site products. Process reviews and hands-on measurements were used to identify initial opportunities for energy efficiency improvements. Each team member was assigned specific projects for which he was the Primary Person Responsible. Actual implementation of various projects was entrusted to site operations personnel, BASF Engineering, or on-site contracted labor. Team meetings were regularly held and progress as measured by the project tracking methodology was reported to Site and Business management. SER tracking was made a monthly communications media to promote site energy awareness; SER graphs are now posted throughout the facility. Among implemented activities that contributed to 2002 energy savings were bag-house delta-p control system; labeling system; steam control; steam trap repair; leak repair within steam, nitrogen and compressed air systems; nitrogen consumption reduction; air compressor sequencing; and, improved utility monitoring. Annualized energy savings were 7.55% of site energy needs, equivalent to 140,000 MMBTU, with a related CO_2 emission reduction of 8,750 tons.

Number: **17**
Company: ATOFINA Chemicals, Inc.
Category: Energy Efficiency Program - Plant Site – **Exceptional Merit**
Entity: Memphis, Tennessee Plant
Title: Improving Yield and Reducing Energy

Description: Notwithstanding significant energy efficiency improvements and related cost reductions the previous five years, current business conditions made survival a key concern and necessitated further reductions in energy consumption and related costs. To do this, site personnel questioned current practices and developed improvement teams with operational and technical functions. The site's original design basis was reviewed. Outside experts were utilized and knowledge from other company facilities applied to this site. This site participated in a competitive benchmarking survey. Following evaluation of all resource uses, many energy-saving improvements were identified and implemented: three reactors were modernized and one shut down; product purification steps were improved and one shut down; equipment was idled; the cooling system was analyzed and optimized; seasonal changes were made to minimize use of cooling tower fans and pumps; steam useage was decreased through process and procedure changes and utilizing waste heat for pre-heaters; steam vacuum jets were replaced with vacuum pumps; and, a solvent involved in by-product recovery was replaced. Natural gas, electricity and steam savings -- much larger than anyone had expected -- were achieved through these steps. Annualized energy savings were 21.8% per unit of production, equivalent to 236,400 MMBTU, with a related CO_2 emission reduction of 14,100 tons.

Number: **18**
Company: ATOFINA Petrochemicals Inc.
Category: Significant Improvement in Manufacturing - Plant Site
Entity: Bayport, Texas HDPE Site
Title: ATOFINA Bayport's HDPE Extrusion Upgrade

This site produces high density polyethylene. Maintenance issues and product quality requirements led to a decision to replace 1980 vintage extrusion equipment in the Bay 1 operating unit with more modern and reliable equipment. Three independent extruder trains would be replaced by a new, single train extrusion unit. This single train design would eliminate the need for redundant additive feeding systems, multiple large (> 1500 hp) electrical motors and large, steam-heated process equipment. During the 18 month engineering and construction process, before the public comment period for the air permit revision, a presentation on the specifics of the project was made to the local citizens' advisory council – Seashore Citizens' Advisory Council, or SEACAP. In part because of this pro-active approach no comments opposing the permit amendment were submitted to the authorities. After start-up, the new unit not only increased on-stream time, production throughput and product quality, but had a dramatic effect on utility costs for operating the unit. Annualized energy savings were 12.3% per pound of production, equivalent to 212,200 MMBTU, with a related CO_2 emissions reduction of 13,973 tons.

Number: **20**
Company: ExxonMobil Chemical Company
Category: Significant Improvement in Manufacturing - Project
Entity: Beaumont, Texas Chemical Plant
Title: Water Still Optimization

Description: This plant was challenged to optimize water still energy consumption due to reboiler duty. To meet the challenge it was decided to convert the continuous process in question into a batch operation. To do this, a convenient alternative water source was utilized as a substitute for the water still overhead stream. This allowed the water still to be shut down most of the time and operated only on a limited basis as needed for make-up water. It took only approximately one month to develop, install and implement this project. Nevertheless, substantial energy savings in the form of natural gas were achieved. On an annualized basis, the energy savings were 86.8%, equivalent to 143,500 MMBTU, with a related CO_2 emission reduction of 8,323 tons.

Number: **21**
Company: ExxonMobil Chemical Company
Category: Significant Improvement in Manufacturing - Project
Entity: Baton Rouge, Louisiana Chemical Plant
Title: Oxo Steam Recovery Project

Description: This plant was challenged to reduce the quantity of steam wasted and, thus, the quantity of natural gas needed to fire boilers. A 600 psig steam condensate return stream from the Oxo Unit was originally being routed to an atmospheric flash drum. A project was conceived to install the facilities -- a new flash drum, instrumentation and piping – to flash the condensate at 130 psig and thus create a new source of medium pressure steam. Completion of the project turned the Oxo Unit from a net steam consumer to a net steam producer. The lesson learned from the low cost and favorable outcome of this activity is that energy efficiency improvement does not have to come from a novel, breakthrough or high cost idea. Annualized energy savings were 12%, equivalent to 140,000 MMBTU, with a related CO_2 emissions reduction of 8,120 tons.

Number: **23**
Company: ExxonMobil Chemical Company
Category: Significant Improvement in Manufacturing – Project – **Exceptional Merit**
Entity: Baton Rouge, Louisiana Chemical Plant
Title: Extraction Steam Controls at EPLA-W

Description: ExxonMobil's Baton Rouge site encompasses a world-scale refinery, chemical plant and third party power station. Historically, inflexible and unreliable control systems on two high-pressure, extracting/condensing steam turbines prevented the site from fully optimizing its steam balance. Thus, the project's key challenge was to develop controls sophisticated enough to optimize steam balance from a site-wide perspective. The project upgraded the hardware of two turbine control systems, replaced old control valves and developed advanced control applications to automatically vary steam extraction to match the medium-pressure steam demand. The ability to manipulate medium-pressure steam extraction enables the site to produce the most economic marginal source of steam. Depending on steam demand, increasing extraction can reduce steam letdown through a control valve, and reducing extraction can minimize steam venting. Annualized energy savings from this project, based on boiler fuel savings (natural gas), are 4%, equivalent to 150,000 MMBTU, with a related CO_2 emissions reduction of 8,700 tons.

Number: **24**
Company: ExxonMobil Chemical Company
Category: Significant Improvement in Manufacturing – Project
Entity: Baton Rouge, Louisiana Chemical Plant
Title: Ethane Cracking Modernization - ECLA-W 'C' Furnace

Description: This project was designed to support a debottleneck of the Baton Rouge Steam Cracker. Construction of this state-of-the-art, energy efficient cracking furnace made possible expanded ethane cracking as well as the shift away from older, less energy efficient furnaces. The new furnace incorporates ExxonMobil's latest furnace technology including high pressure steam-generating transfer line exchangers and low Nox burners. Notable are its improved heat recovery, a more efficient convection section compared to existing furnaces and a stack temperature 410° F lower than in older model furnaces. The company will continue to shift ethane cracking to newer, more efficient furnaces. The technology employed in this furnace design is available to other companies through a licensing agreement. Annualized energy savings from this project are 11.8% per unit of production, equivalent to 122,000 MMBTU, with a related CO_2 emissions reduction of 7,076 tons.

Number: **25**
Company: ExxonMobil Chemical Company
Category: Environmental Impact – Operating Unit
Entity: Beaumont, Texas Chemical Plant
Title: Distillation Tower Specification Changes

Description: The plant's challenge was to optimize the distillation tower's energy performance. The technical approach was to optimze the tower overhead composition by reducing the reflux rate while maintaining the product within specifications. Development and implementation time combined was well under one year. Energy savings and environmental benefits exceeded initial estimates by 50%. The project and its results have been communicated to corporate headquarters energy staff for appropriate dissemination thoughout the parent corporation. Annualized energy savings were 25%, equivalent to 340,000 MMBTU, with a related CO_2 emission reduction of 19,720 tons.

Number: **26**
Company: Lyondell Chemical Company
Category: Energy Efficiency Program – Operating Unit
Entity: Channelview, Texas Complex
Title: Reduced Nitrogen and Natural Gas Consumption at Deepwell Flare

Description: Facing both an economic downturn and the liklihood of steep natural gas price increases, company plants were challenged to identify and quickly implement energy saving projects that would reduce natural gas usage. Unit operating personnel and engineers were challenged to look outside the box and question the status quo. Operating personnel thereupon identified one energy savings opportunity regarding the supply of nitrogen and natural gas to a deepwell flare. A small flow of nitrogen is required to maintain minimum velocity in the flare stack. A 2" nitrogen line was used for this purpose. However, this line had no flow restriction orifice or working flow meter; rather, an open valve allowed the flow. Investigation determined that whereas the required nitrogen flow for minimum stack velocity was 7.5 scf/m, roughly 667 scf/m were being supplied to the flare. The 2" line was blocked in and nitrogen consumption was reduced by 660 scf/m. In addition, consumption of natural gas, added to the flare to keep above the regulatory requirement of 300 BTU/scf heating value, was reduced. After the nitrogen flow was controlled and reduced, the calculated natural gas addition set point was lowered from 470 BTU/scf to 350 BTU/scf. The state of affairs preceding this activity had been in place for several years and never given a second thought by site personnel. By questioning what were considered "normal" operations a significant energy saving was achieved without spending any capital or expense money. Results of this and other energy savings activity are shared throughout Lyondell and Equistar. Annualized energy savings, based only on natural gas, are 1.9%, equivalent to 167,000 MMBTU, with a related CO_2 emission reduction of 9,976 tons.

Number: **27**
Company: Lyondell Chemical Company
Category: Energy Efficiency Program – Plant Site
Entity: Lake Charles, Louisiana Manufacturing Facility
Title: Lake Charles Energy Reduction Team

Description: The Lake Charles Energy Reduction Team identified three energy savings possibilities: two involving steam usage in distillation systems, and one involving potential usage of steam previously vented at a neighboring facility. Historically, the operations of the distillation systems have not been changed unless there were quality problems. Changing the extablished steam system operating pressure had not been considered as practical. Thus, the major challenges facing the projects were the need to overcome established past practices and to instill the realization of the need for change. To reduce steam usage for the distillation columns, Aspen modeling of the distillation systems was performed. Additionally, investigation of past performance versus the steam flow to each column was performed. These analyses provided a justification for the changes with a probability of success. As a result of the steam reductions, the product quality was not noticeably diminished. On one distillation system the product quality actually improved because the reduced steam flow lowered the percent flood of the column. The neighboring facility's excess steam had traditionally been vented because its pressure was below the typical Lyondell steam header pressure. Analysis of the Lyondell site's steam pressure requirement was performed to detail the limiting heat trasfer location and to assure that heat transfer requirement would still be satisfied at lower steam pressure. Following this analysis, Lyondell steam header pressure was reduced in stages with analysis of the performance of the limiting exchanger. As the pressure was reduced, more of the neighbor's previously vented steam was able to enter the Lyondell steam system. Coordination with the neighboring steam supplier was effected to ensure that the correct steam pressure was continually supplied. To date about 75% of the neighboring facility's previously vented steam has been put to use, resulting in the displacement of Lyondell's previous natural gas-fired boiler steam production. Efforts are ongoing to recover the neighbor's remaining vented steam. Annualized energy savings are 10.7% of site steam usage or 3.7% of site energy usage, equivalent to 186,000 MMBTU, with a related CO_2 emission reduction of 10,000 tons.

Number: **28**
Company: Equistar Chemicals, LP
Category: Energy Efficiency Program – Plant Site – **Exceptional Merit**
Entity: Morris, Illinois Plant
Title: Morris Plant Energy Efficiency Program

Description: The Morris Plant consists of an olefins unit, three polymers units, a utility area and a third-party cogeneration unit. The plant is highly energy integrated; its energy savings program is mature, and its achievements have previously been recognized by an ACC Energy Efficiency Award. Notwithstanding its previous energy savings, a site goal of 2.25% energy savings (as BTU/lb product) was established for 2002 over 2001. For yet another consecutive year, a significant improvement in energy performance was realized. The site's Morris Plant Energy Best Practice Team, consisting of representatives from operating units and maintenance groups, meets on a monthly basis to address energy improvement opportunities. Energy goals are established for each of the operating units on an annual basis. Performance against these goals is tracked on a monthly basis, and is a major focus of the Energy Best Practice Team. Pursuant to this program, the following projects were implemented in 2002: I. Steam. Additional projects to minimize venting and letting down steam included: a) Plant-wide high-pressure steam use is reported daily to a broad voice-mail distribution and significantly abnormal usage quantities are investigated. b) New transfer line exchangers (TLEs) fitted with larger tubes were installed on seven olefins cracking furnaces to improve heat recovery from the cracked process gas. c) Owing mainly to the big tube TLE's, monitoring steam letdown valves and incresing the deaerator pressure operating range, three new monthly record lows were achieved for high-pressure steam use. d) A malfunctioning steam letdown valve, identified by a plant-wide data historian, was repaired and enabled improved control of medium pressure steam for the polymenr units. e) Steam quality was coordinated between olefins and the third-party cogeneration facility. This enabled increased high-pressure steam superheat temperature and subsequent drip leg steam trap elimination. f) A communication link to enable transmittal of energy data

between the cogeneration and Equistar DCS systems was installed. By monitoring the Equistar fuel gas system the cogeneration unit has mimimized the plant's flaring of fuel gas by increasing their flow of Olefins off-gas. g) Improvements were made to optimize the olefins steam superheater, resulting in increased heat recovery and improved fuel gas balance. II. Other. Plant operations staffing resources were provided by plant management in order to address energy-related issues such as burners on fired heaters, compressed air systems and turbine-driven equipment. Annualized energy savings from these activities were 2.6% per unit of production, equivalent to 460,000 MMBTU, with a related CO_2 emission reduction of 17,300 tons.

Number: **29**
Company: Equistar Chemicals, LP
Category: Energy Efficiency Program – Plant Site
Entity: Clinton, Iowa Facility Energy Best Practice Team
Title: Clinton Plant Energy Efficiency Program

Description: The site's Energy Team had met with moderate success over several years in identifying and implementing energy saving ideas. However, interest and participation in the team had waned as other priorities and issues arose. The challenge was to revitalize the team, gain the interest and participation in the program of all plant personnel up to the Plant Manager, and to further improve plant energy awareness and energy efficiency. Steps taken in 2002 to revitalize the team consisted of: a) review and revision of the team charter; b) publishing quarterly newsletters re-emphasizing the importance of energy efficiency; c) replacement of transferred team members and inclusion of new members from additional areas; d) active involvement in Lyondell's and Equistar's corporate energy programs; and, e) working with vendors. A culture shift has occurred within the plant and energy optimization is included in the daily activities for operators, engineers and managers. Key performance indicators are tracked daily and evaluated daily. As a result of this team revitalization and team activities the plant in 2002 achieved its largest one year energy savings. The program continues to provide new ideas and opportunities for further improvement. Among the projects implemented in 2002 were: a) upgrading and improvement in steam letdown valve design for the 300 psig steam header; b) optimization of cooling water tower fan operation during cold weather conditions; c) upgrading and replacing steam shut-off valves for the steam supply to the flare to reduce steam leakage; d) optimization of the steam letdown set-points and flows within the steam headers in the polymer units; and, e) development of a list of energy-related repairs to equipment that could be implemented if a shutdown were to occur. Many of these repairs were ready and were implemented when a plant shutdown happened during the year. Annualized energy savings from these activities were 1.45% per pound of production, equivalent to 210,000 MMBTU, with a related CO_2 emission reduction of 12,500 tons.

Number: **30**
Company: DuPont
Category: Energy Efficiency Program – Business Unit – **Exceptional Merit**
Entity: Wilmington, Delaware DTT Energy Team
Title: DTT Energy Reduction Project

Description: DuPont Titanium Technologies has developed a sustainable growth strategy that includes an initiative focused on improving energy efficiency. The energy efficiency initiative is a disciplined approach that began with creation of an Energy and Greenhouse Gas Steering Team in 2001. That team developed energy and CO_2 reduction strategies and a year 2010 energy reductoin goal. That goal is to reduce per unit energy consumption by over 25% compared to 2000. A team of eleven individuals drawn from seven plant sites was established to discuss and explore concepts, to develop specific reduction plans in support of the 2010 goal and to implement specific projects. Twenty small projects or possible projects needing further study were identified. Su-teams were assigned to investigate projects and review economic feasibility. Projects were then implemented based on the highest potential. There were two main areas of focus for study and subsequent implementation. The first consisted of standard techniques of improving energy efficiency such as O_2 trim of fired units, re-insulation, and steam trap maintenance. The second area of focus was fundamental process changes that had previously been ignored. Factors contributing to this overall project's success include management's commitment of technical resources' time – the eleven

people assigned to the team spend about 25% of their time on the project – and the organized method of execution. The overall project is scheduled for completion in the 2004-2006 period. However, savings are already being realized. Annual energy savings for 2002 were 4%, equivalent to 1,051,080 MMBTU, with a related CO_2 emission reduction of 86,189 tons.

Number: **31**
Company: Eastman Chemical Company
Category: Significant Improvement in Manufacturing – Operating Unit
Entity: Tennessee Operations, Kingsport
Title: Energy Minimization of a Dimethyl Terephthalate Refining Facility

Description: Dimethyl terephthalate (DMT) is a chemical intermediate used in the production of polyethylene terephthalate (PET) polymer. The energy used to refine DMT is the primary cost in the operation of this facility. Historical operation of three parallel refining trains produced DMT product that was highly variable in product quality, which in turn resulted in routine over-purification. The challenge was to produce DPT consistently to a specific quality target while minimizing energy usage across the parallel refining trains. The technical approach consisted of gathering operating data and evaluating process control improvements using dynamic process model simulations. Opportunities for changing column operations and composition profiles were discovered that would maximize impurity removal. Opportunities for optimizing use of process equipment that was most enery efficient were also available because of hardware differences. Insight gained from this analysis led to the development and implementation of advanced control strategies. The new automatic control system sucessfully utilizes both on-line and off-line process measurements to produce consistent DMT product while minimizing product losses in waste streams, and to optimally distribute refining train feed rates to minimize overall energy usage. Operator training was an essential prerequisite to implementing the new system. Because of corporate capital limitations it was important to achieve the product benefits with little or no capital expenditure. Essentially all project objectives were reached by utilizing existing equipment, hardware, measurements and piping. Annualized energy savings are 9% per unit of production, equivalent to 43,700 MMBTU, with a related CO_2 emission reduction of 4,600 tons.

Number: **32**
Company: Eastman Chemical Company
Category: Significant Improvement in Manufacturing – Operating Unit
Entity: Tennessee Operations, Utilities Division, Kingsport
Title: Balancing 100-PSI Steam Systems Using Feedwater Heaters

Description: Eastman's Tenessee Operations operates two segregated 100-PSI steam systems in order to prevent potential steam contamination, arising from process leaks, from the system in the Coal Gasification portion of the plant -- the "Gasifier" steam system – to the system serving the rest of the plant – "the Utility" steam system. Pressure control in each system is achieved separately. Prior to this project the 100-PSI Gasifier steam system pressure was regulated by using a 100-PSI steam vent and a reducing station that let down 600-PSI Utility system steam into the 100-PSI Gasifier steam system. Typical operation of the 100-PSI steam system prior to the project resulted in operation of the reducing station in order to maintain pressure in the system. For this project, a steam balance control system was installed on two feedwater heaters in a Utilities Division powerhouse that had been used to condense only 100-PSI Gasifier steam. The control system consisted of piping and control valves to allow variable amounts of both Utility and Gasifier steam to be admitted to the feedwater heaters. To prevent the possible contamination of the Utility steam system by Gasifier steam, the control valves maintain a lower pressure on the 100-PSI gasifier steam header. In addition, a check valve was installed in the 100-PSI Utility supply as an additional protection. In effect, this new arrangement created a controllable, variable condensing load on the Gasifier steam system, which allowed the steam flow through the Gasifier system to be reduced on a continuous basis. Moving the condensing load to the Utility steam system allowed the 100-PSI steam to be produced in the most efficient way with turbine generators letting down 600-PSI steam. The project resulted in a net reduction in reducing station flow from an average of 58,760 lb/hr in 2001 to an average of 15,140 lb/hr in 2002. This net reduction resulted in increased generation of electric power by the turbine

generators of just over one megawatt compared to the previous method of operation. Even though the system could not be perfectly balanced, energy savings from the project exceeded expectations. Annualized energy savings (avoided electricity purchases) were 10.2%, equivalent to 87,600 MMBTU, with a related CO_2 emission reduction of 5,874 tons.

Number: **33**
Company: Eastman Chemical Company
Category: Environmental Impact – Operating Unit
Entity: Tennessee Operations, Waste Disposal Services Department, Kingsport
Title: Savings from Ammonium Nitrate Addition to Wastewater Treatment

Description: Eastman's wastewater is nitrogen-deficient and requires the addition of ammonia to provide the essential macronutrient to microorganisms that carry out the wastewater treatment process. A local munitions manufacturer was seeking an outlet for an ammonium nitrate solution byproduct. Eastman's Operations employees recognized that the byproduct had the potential of serving a dual function at their wastewater treatment facility. The ammonium component could provide the nitrogen needed by the microorganisms and the nitrate component could serve as an oxygen substitute during bacterial respiration. The challenge was to develop a feed strategy that would allow both functions to be performed while fully utilizing the byproduct. Using MSDS data, a spreadsheet was developed to estimate the appropriate feedrate of the ammonium nitrate solution. Trials were conducted and the ammonia and nitrate residuals in the aeration basins were closely monitored. Initial and long-term monitoring indicated that the ammonia in the ammonium nitrate solution worked well in the treatment plant and that the nitrate portion was utilized or removed prior to clarification. The ammonium component of the solution replaced 65% of the refrigeration grade ammonia that previously had been used and also saved on costs to run the vaporizer supplying ammonia to the treatment plant. The nitrate component by supplying oxygen reduced the overall electrical cost of the aeration system. This successful project resulted in the beneficial use of a difficult-to-market byproduct. The chemistry of this project should be applicable at other nitrogen-deficient wastewater treatment plants, but the cost-effectiveness of the project would depend on the byproduct's purchase price and transportation costs, both of which were highly advantageous to Eastman in this case. Annualized energy savings were 3.5% of aeration system electrical usage, equivalent to 5,194 MMBTU, with a related CO_2 emission reduction of 348 tons.

Number: **34**
Company: Eastman Chemical Company
Category: Significant Improvement in Manufacturing – Plant Site – **Exceptional Merit**
Entity: Texas Operations, Longview
Title: Energy & Environmental Benefits from Steam & Electricity Cogeneration

Description: Eastman's Texas Operations (TEX) occupies a 6,000 acre site where it manufactures more than 60 major products and employs 1,800 persons in a complex of more than 200 buildings. TEX is Eastman's largest single consumer of energy; its processes require large quantities of steam and electricity. Prior to this project TEX purchased electricity from the local utility and generated steam from two on-site powerhouses (one coal-fired and one natural gas-fired) and from gas-fired and waste heat boilers in its four hydrocarbon cracking plants. The challenge was to find a way to reduce costs and improve reliability of procuring and/or producing electricity and steam while maintaining or reducing TEX air emissions. TEX entered into an agreement with Eastex Cogeneration to build, own and operate a 440 MW gas-fired steam and electric cogeneration facility on site. Implementation of the project was complex and required major effort by both Eastman and Eastex, as well as close coordination with the local utility. Eastman reconfigured its electrical interconnections to the local utility grid, while Eastex and the utility reconfigured the utility's local transmnission grid to interconnect with both TEX and the cogeneration plant. Eastman Engineering coordinated its efforts with Eastex to provide services such as boiler feed water, cooling water, and wastewater treatment, and to interconnect the cogeneration plant with the TEX steam distribution system as well as an adjoining cracking plant's high pressure steam internal distribution system. A major investment was made to upgrade control systems in the remaining TEX powerhouse (see below) and to link control systems with Eastex to insure smooth and reliable operation of the steam distribution systems. The new cogeneration facility consists of two combined cycle combustion turbines and a condensing steam

turbine. It provides all the electricity required by TEX and sells excess power to wholesale customers in the region. It provides a large portion of TEX steam requirements, with sufficient reliability such that TEX decommissioned its coal-fired powerhouse and reduced operations of the remaining powerhouse and the cracking plants' steam boilers, significantly reducing NOx emissions. The project reduced TEX costs by millions of dollars annually. Annualized energy savings were 17%, equivalent to 3,500,000 MMBtu, with a related CO_2 emission reduction of 473,000 tons.

Number: **35**
Company: Monsanto Company
Category: Energy Efficiency Program – Operating Unit
Entity: A-Unit Manufacturing Team, Muscatine, Iowa
Title: A-Unit Area Energy Efficiency Improvement Program

Description: The challenge was to identify new opportunities for cost reduction. Utilities (electricity, steam and natural gas) were chosen as a focus area both for cost management and as part of Monsanto's ongoing commitment to sustainable development. The first step was to form a cross-functional team. Software was developed to measure and track energy use and to provide a basis for improvement. Brainstorming was used to identify equipment and/or systems that were not being fully utilized or efficiently operated, and to identify means of reducing energy use during periods of inactivity. Many current procedures and practices were questioned. Testing was undertaken to verify appropriate set points or operating conditions. Numerous projects were managed and implemented, including the following: I. Steam Use Reduction. 1. Automation of jets: computer-controlled valves were added to shut off steam to jet eductor vacuum systems when the system was not required. 2. Elimination of Finished Goods Jet System: this system provided excess vacuum capacity. It was dismantled and an alternate system connected. 3. Steam Trap Testing: a program was revived and enhanced to improve preventive maintenance and reduce steam losses. 4. Shutdown excess equipment capacity: capacity was improved in two of three process trains, allowing shutdown of the third train for nearly six weeks of run time. 5. Increasing operating rate: improved utility tracking enabled updating of production cost models to demonstrate a more energy efficient and cost effective mode of operation. 6. Implementation of a control program to reduce steam feed to incinerator when waste is not being fed. II. Natural Gas Use Reduction: testing of a gas-fired incinerator for process waste streams led to operation at lower gas use rates. III. Electricity Use Reduction. 1. Configuration of cooling valves on reactor: use of automated valves enabled reduced total cooling flow and, thus, electricity consumption by large motor when cooling is not needed. 2. Configuration of Scrub Pumps: scrubber pumps that previously ran continuously are now shut down between batches. 3. Chiller Replacement: 1970's vintage chillers were replaced with new, energy efficient units. 4. Cooling Tower Variable Speed Drive Installation: an existing two speed cooling tower fan was replaced with a variable speed drive model. 5. An operator-generated checklist ensures that any unnecessary equipment is shut down during idle periods. This program is a continuous improvement program and numerous improvement opportunities continue to be identified and implemented. Annualized energy savings were 8.5% per unit of production, equivalent to 19,000 MMBTU, with a related CO2 emission reduction of 263 tons.

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